1857MNRAS..17..230B

Catalogue. This nebulosity appeared to me subject to considerable changes of brightness.

"4. A sort of narrow channel, that connects in apparently a straight line the black space round the stars 76, 80, and 84, of Herschel's Catalogue, with the northern border of the *Sinus Magnus*, where it has its mouth near to the outer extremity of the before-mentioned bridge. This channel, that never has been represented by any other observer, was distinctly seen on March 24; but I could not entirely satisfy myself if it was interrupted or not in the neighbourhood of the star 87. On former occasions, when I had very carefully reviewed this same portion of the nebula, I had never seen a trace of the channel. The space round the three mentioned stars appeared to me sometimes quite dark, sometimes filled with nebulosity; but even when this nebulosity was the strongest, it was regularly defined, and appeared throughout of an uniform light, without any gradation similar to that represented by Herschel.

"My journal contains yet some more indications of suspected changes, but in no other case, besides the four mentioned, do I estimate the suspicion strong enough to invite other astronomers to direct their particular attention to them. However, I may add, that the general impression I have derived from the observations of this year has been that the central part of the nebula of *Orion* is in a state of continual change with regard to the brightness in different parts of it. Even with the best definition of images, its appearances were to me on no evening entirely agreeing with those on the next or any other night. Perhaps it will save trouble to astronomers, not provided with great telescopes, if I remark, that for the greater part such changes in the gradation of light can only be seen with very high optical means. In my opinion refractors of less than 10 inches aperture, if not supported by an extraordinary state of the atmosphere, would hardly prove themselves equal to the task.

"1 *May*, 1857."

Letter from Mr. Bond, Director of the Observatory, Cambridge, U. S., to the Secretary.

"It affords me pleasure to communicate the following results of our experiments instituted at this Observatory for the purpose of delineating the positions of a group of stars by the aid of photography.

"On the evening of the 27th of April the actinic apparatus was affixed to the 23-feet equatoreal. The groups of stars to be experimented upon consisted of *Mizar*, second magnitude, its companion of the fourth magnitude, and *Alcor*, of the fifth magnitude. These were taken simultaneously by the collodion

1857MNRAS..17..230B

process. The images were distinct, and, although covering some seconds of arc, were so perfectly symmetrical that they were capable of very nice bisection. On the following day they were measured in distance, by Mr. Alvan Clark, with a reading microscope, as follows:—

Mizar to *Alcor.*	*Mizar* to companion.	Angle at *Mizar* between *Alcor* and companion.
r d	r d	
14 304·5	0 109·2	
303·6	110·5	
303·5	110·5	° ′
303·0	110·3	75 55
303·6	110·3	76 05
14 303·6	110·2	76 00

One revolution of the micrometer-screw is subdivided into 360 parts.

"From these measurements of the photographic images we obtain

"*Mizar* to *Alcor* $= 14^{\mathrm{r}}{\cdot}8433$; *Mizar* to companion $= 0^{\mathrm{r}}{\cdot}3061$; distance of companion $= 0{\cdot}02062$ of distance of *Alcor.*

"To reduce this to seconds of arc we have from the Greenwich catalogue:—

Diff. Right Ascension *Mizar* and *Alcor* $= 1^{\mathrm{m}}\ 19^{\mathrm{s}}{\cdot}67$
,, Declination ,, ,, $= 3'\ 40''{\cdot}3$

which gives the distance of *Alcor* from *Mizar* $= 707''{\cdot}8$ in an arc of a great circle, and the distance of the companion from *Mizar* $707''{\cdot}8 \times 0{\cdot}02062 = 14''{\cdot}6$.

"The computed angle of position of *Mizar* and *Alcor* is 72°·0. Adding the difference of the angles of position of the companion and *Alcor*, we obtain for the angle of position of the former $72^{\circ}{\cdot}0 + 76^{\circ}{\cdot}0 = 148^{\circ}{\cdot}0$.

"Struve's observations, 'Positiones Mediæ,' Introd. p. 215, are as follows,—

	Distance.	Angle of Position.
	″	°
1830·63	14·37	147·6
1840·77	14·35	147·7
1847·65	14·25	148·2
Mean	14·33	147·8

"The observations of Bradley and Herschel in the last century prove that there is very little, if any, relative motion of the two stars. Taking Struve's places as correct for the present epoch, we have the following comparison between the photographic angles and those derived from direct measurement.

1857MNRAS..17..230B

"Angle of position and distance of *Mizar* (ζ *Ursæ Majoris*) and its companion:—

		Photographic.	Struve.
Angle of Position	=	148°·0	147°·8
Distance	=	14″·60	14″·33

"Whether this close agreement is to be attributed partly to accident must be determined from further experiments, but it may be well to state that from the manner in which they have been obtained there could have been no bias in the measurements favourable to the photographic results.

"Some six years ago we published in the *Boston Traveller* an account of our having obtained daguerreotype impressions of the stars *Vega* and *Castor* by the aid of the great refractor, but at that time it was found impossible to extend the process to stars of lesser magnitude. This was attributed to the want of sufficient susceptibility in the daguerreotype plates, and to deficiency of power and regularity in the machinery designed for giving to the telescope uniform sidereal motion. These deficiencies have been recently supplied, first, by the construction of a driving-clock on the principle of the 'spring-governor,' in which the rotary motion of the fly-wheel is regulated by an oscillating pendulum, which has been found, from several years' practical application, to be the most perfect regulator of rotary motion yet devised. A machine of this description has been adapted to the great telescope by those excellent mechanicians, Messrs. George Clark and Alvan Clark, jun., of East Cambridge, assisted by their father, Mr. Alvan Clark, sen.

"This point having been satisfactorily accomplished, we obtained the assistance of Messrs. Whipple and Black, whose skill as daguerreotypists is unsurpassed, and whom we knew to be deeply interested in the success of the experiment: it is to those gentlemen that we are principally indebted for whatever of success has crowned our efforts in the perfect delineation of stars of the lesser magnitudes.

"I should mention that a zero for angle of position is obtained with neatness and precision by allowing the star, after the first impression has been taken, to move forward by its diurnal motion, and then renewing the image on the same plate. The line joining these two images will represent the direction of the circle of declination. We have several series of *Mizar* and *Arcturus* taken in this way.

"P.S.—Since the above was written we have measured the distance between *Mizar* and its companion from plates taken on four different nights—the angles are all but identical—showing that the first measures were not the result of accident.

1857MNRAS..17..233A

At the close of the meeting the Astronomer Royal made an oral statement respecting certain ancient eclipses which have recently engaged his attention. A few years ago he communicated to the Royal Society a paper on the eclipses of Thales and Agathocles which was published in the *Philosophical Transactions* of that body for the year 1853. The circumstances connected with both these eclipses are known to every reader of ancient history. The eclipse of Thales happened during the occurrence of a battle between the Medes and Lydians; and according to Herodotus, the combatants on both sides were so terrified by the spectacle that an immediate cessation of hostilities ensued, and peace was concluded between the two nations. The account of the eclipse of Agathocles which has been given by the ancient writers is also associated with a very remarkable incident. Agathocles having been closely blockaded in the harbour of Syracuse by a Carthaginian fleet, took advantage of a temporary relaxation of the blockade occasioned by the enemy going in pursuit of a relieving fleet of ships laden with provisions, and quitting the harbour of Syracuse he landed on the opposite coast of Africa, and laid waste the Carthaginian territories. It is stated that the voyage to the African coast occupied six days, and that an eclipse (which from the description was manifestly total) occurred on the second day.

The late Mr. Baily, in a paper published in the *Philosophical Transactions* for 1810, had come to the conclusion that the eclipse of Thales must have occurred in the year 610 B.C., but he found it impossible by means of the same elements of the moon's orbit to satisfy the conditions of the eclipse of Agathocles.

The object of the Astronomer Royal in the paper above mentioned was, by means of the improved state of lunar astronomy, to fix the precise time of the occurrence of the eclipse of Thales using for this purpose the eclipse of Agathocles as a critical eclipse and supposing the place of the moon's node to be liable to error. The conclusion at which he arrived was that an eclipse which occurred in the year 584 B.C., is the one referred to by Herodotus, and not the eclipse of 610 B.C., as Baily supposed.*

The subsequent researches of Mr. Adams on the secular acceleration of the moon's mean motion, and the publication of the Solar Tables of MM. Hansen and Olufsen, having led Mr. Airy to suspect that the groundwork of his previous calculation was imperfect, he proceeded to investigate the subject anew. On this occasion he employed in his researches (in combination with the eclipses of Thales and Agathocles) the eclipse of Larissa, to which his attention had been invited, first by Mr. Hind, and afterwards by Mr. J. Bosanquet. This eclipse is mentioned by Xenophon in the *Anabasis*, as having led to the capture by the Persians of a Median city which he calls Larissa. In the retreat of the Greeks on the eastern side of the Tigris, not long after the seizure of their

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* Mr. Airy here stated that a similar conclusion had been derived by Mr. Hind from good elements.

1857MNRAS..17..233A

generals, they crossed the river Zapates, and also a ravine or steep watercourse, and then came to the Tigris. At this place there stood, according to Xenophon, "a large deserted city called Larissa, formerly inhabited by the Medes; its wall was 25 feet thick, 100 feet high; its circumference 2 parasangs; it was built of burnt bricks, placed upon an understructure of stone 20 feet high. When the Persians obtained the empire [of the east] from the Medes, the king of the Persians besieged the city, but could not in any way take it, but a cloud covered the sun and caused it to disappear completely, till [*i. e.* to such a degree that] the inhabitants withdrew, and thus the city was taken.* Close to this city was a pyramid of stone, 1 plethrum in breadth, 2 plethra in height. Thence the Greeks proceeded 6 parasangs to a great deserted castle, by a city called Mespila, formerly inhabited by the Medes; the substructure of its wall was of squared stone abounding in shells; the king of the Persians besieged it, but could not take it; Zeus, however, terrified the inhabitants with thunderbolts, and so the city was taken."

The minute description here given by Xenophon has enabled Layard, Jones, and others, to identify Larissa with the modern Nimrûd, and Mespila with the Mosul of the present day. It is plain that the phenomenon to which the Greek author refers as having led to the capture of Larissa, was no other than a total eclipse of the sun.

The Astronomer Royal accordingly examined approximately all the eclipses which occurred within an interval of forty years, including the given period, and having selected two he computed them accurately, but found them inapplicable. He then tried another (556, May 19, B.C.) which he had previously passed over because he doubted its totality, and had the great satisfaction of finding that the eclipse, though giving a small shadow, was total, and that it passed so near to Nimrûd that there could not be a doubt of the eclipse sought.

Mr. Airy then proceeded to explain the method of investigation which he employed in the discussion of these ancient eclipses. A brief account of this method is given in an abstract of his paper on the subject which will be found at page 243. The conclusion to which he has been conducted by his researches, is that Professor Hansen's Solar and Lunar Tables very well represent the phenomena of the three eclipses of Agathocles (309, Aug. 14, B.C.), Larissa (556, May 19, B.C.), and Thales (584, May 28, B.C.), as far as we can interpret the historical account of those eclipses.

It may be stated that the remarks of the Astronomer Royal were illustrated by topographical sketches of the localities of the

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* Ἡλίον δὲ νεφέλη προκαλύψασα ἠφάνισε, μέχρι ἐξέλιπον οἱ ἄνθρωποι, καὶ οὕτως ἑάλω.—*Anab.* lib. iii. cap. iv. A suspicion is thrown out in some editions of the *Anabasis*, that this may refer to an eclipse of the sun, but the passage seems to have been overlooked by Kepler (*Astronomiæ Pars Optica*), nor has Riccioli included it in the list of eclipses which he quotes from the ancient writers, in his elaborate work the *Almagistum Novum.*— R. G.